Jameco Part number 151482

Ultrasonic Sensor with RS-232 Output

User's Guide

Jameco Part Number 151482

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Product Overview

The 151482 product is an ultrasonic sensor designed to measure the distance between its transducer and a user target. The distance is measured without contacting the target object, and is accomplished by sending an ultrasonic "pulse" and measuring the time for the pulse "echo" to return from the target object. The measured time is related to the speed of sound of the pulse. After the distance (time) is measured, the sensor transmits the distance as binary data on the RS-232 output. Each count of the binary data represents a distance of .013536 inches at nominal speed of sound. The sensor provides data up to a maximum range of 10 feet.

The 151482 consists of a circuit board, ultrasonic transducer, transducer connecting cable, 3.5" DOS compatible floppy diskette, computer connecting cable and this user manual.

Revision History

Initial product release April 1, 1998

Warranty

Senix, Inc. will repair or replace, at our option, any part found by us to be defective in material or workmanship if the product is received by Senix, freight prepaid, within one year from the date of original shipment to buyer.

Disclaimer and Release. The warranties, obligations and liabilities of Senix and the remedies of buyer set forth above are exclusive and in substitution for, and buyer hereby waives, releases and renounces all other warranties, obligations and liabilities of Senix and all other rights, claim, and remedies of buyer against Senix, expressed or implied, arising by law or otherwise, including but not limited to: (A) Any implied warranty or merchantability or fitness; (B) Any implied warranty arising from course of performance, course of dealing or usage of trade; (C) Any obligation, liability, right, claim or remedy in tort, whether or not arising from the negligence of Senix (whether active, passive or imputed); and (D) Any obligation, liability, right, claim or remedy for loss or damage to any product.

Exclusion of Consequential and Other Damages. Senix shall have no obligation or liability, whether arising in contract (including warranty), tort (including active, passive or imputed negligence) or otherwise, for loss of use, revenue or profit with respect to any non conformance or defect in any product delivered under this agreement, or for any other direct, incidental or consequential damages.

Governing Law. The terms and conditions of this agreement shall be governed by the domestic law of the State of Vermont, U.S.A.

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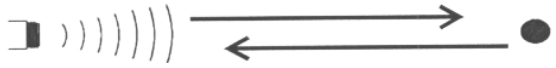
Ultrasonics Overview

Introduction

Ultrasonic sensors measure the distance or presence of a target object by sensing a sound wave, above the range of hearing, at the object and then measuring the time for the sound echo to return. Knowing the speed of sound, the sensor can determine the distance of the object from the transducer element.

(1) Ultrasonic pulse transmitted from sensor



(2) Ultrasonic echo returns from target

Advantages

Non-contact
Measures through the air without touching the target object, at relatively large distances.

Object Ranging
Object distance is measured rather than just the presence or proximity.

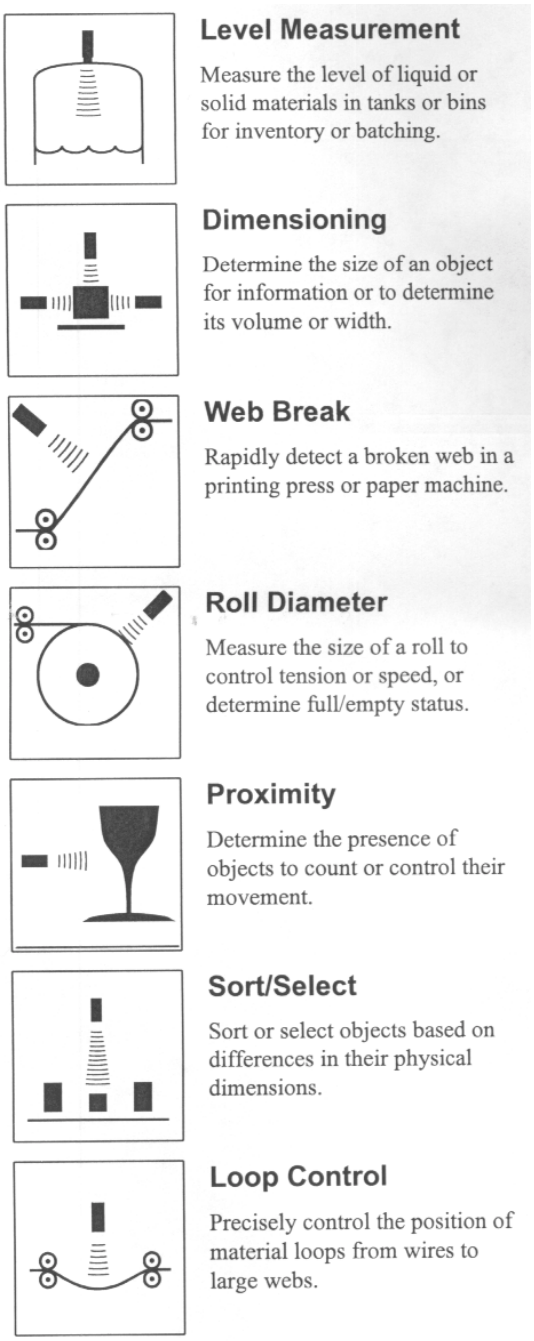
Distance Proportional Output
The sensor's outputs are proportional or related to the measured target range.

High Resolution
Precise discrimination of target position.

Unaffected by Target's Optical Characteristics
The sensor's operation is not sensitive to ambient light levels, the target color, or target's optical transparency or reflectivity.

Sensitive
Detects large and small objects.

Typical Applications


Level Measurement
Measure the level of liquid or solid materials in tanks or bins for inventory or batching.
Dimensioning
Determine the size of an object for information or to determine its volume or width.
Web Break
Rapidly detect a broken web in a printing press or paper machine.
Roll Diameter
Measure the size of a roll to control tension or speed, or determine full/empty status.
Proximity
Determine the presence of objects to count or control their movement.
Sort/Select
Sort or select objects based on differences in their physical dimensions.
Loop Control
Precisely control the position of material loops from wires to large webs.

and many more...

Getting Started

Unpacking

Check that you received the following items:

- Circuit board
- Ultrasonic transducer with connecting cable
- RS-232 Computer Cable
- 3.5" DOS compatible floppy diskette
- This manual

Specifications

Circuit Board

Power Input	8-24 VDC @ 40 ma.
Range	6 inches to 10 feet
Output	RS-232, Transmit only
Output Format	9600 baud, 8 data bits, 1 stop bit, no parity
Output Protocol	3 character burst: #1:55H (sync character) #2: LSB count data #3: MSB count data
Resolution	0.013536 inches/count at room temperature
Temperature	0 to +70 C (32 to 160 F)
Humidity	5-95%, non-condensing
Measurement Period	50 mSec (20 Hz update)
Interface connections	Terminal Block
Transducer connection	2-pin Molex
Weight	1.6 oz.
Size	2.85L x 1.85W x 1.25H

Transducer

Type	Electrostatic Ultrasonic
Frequency	50 kHz
Beam Shape	Conical
Beam Angle	15 degrees total @ 3db down
Temperature	-30 to +70 C (-20 to +160 F)
Board Connection	Blade terminals
Size	1.69" diameter x 0.5" deep
Weight	0.3 oz.

Mounting

Ultrasonic transducer

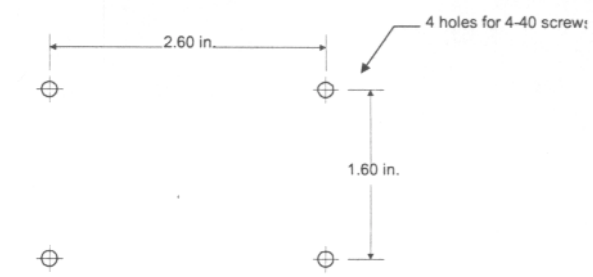
The transducer mounts in a 1.54" diameter circular hole cut into any sheet material. The transducer can be glued using a resilient compound such as GE Silicone Sealant.

Grounding

If the sheet material is metal, surface contact to the transducer will connect the surface to the sensor's ground (PWR-). This is allowable as long as it doesn't conflict with other wiring.

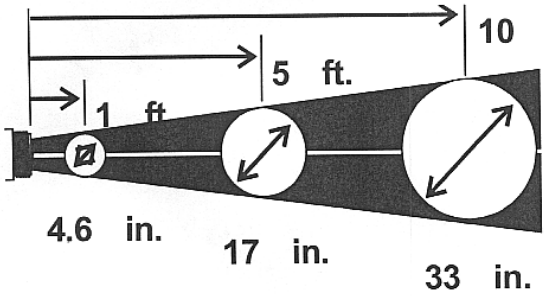
Circuit board

The circuit board mounts on 4 standoffs using 4-40 screws in the following hole pattern:



Beam Pattern

The beam pattern is conical with a total angle of about 15 degrees. The cone starts at the face of the sensor at about 1.5 inches in diameter and grows from there as shown in the diagram below. The beam pattern is approximate and represents the boundary where the return echoes are 3db down.



Orientation

The transducer orientation should be perpendicular to the target object for best results. The sensor will loose the target if the ultrasound energy is reflected away from the transducer rather than back to it. Curved or spherical objects make good targets. Make sure other unintended targets are not visible to the sensor.

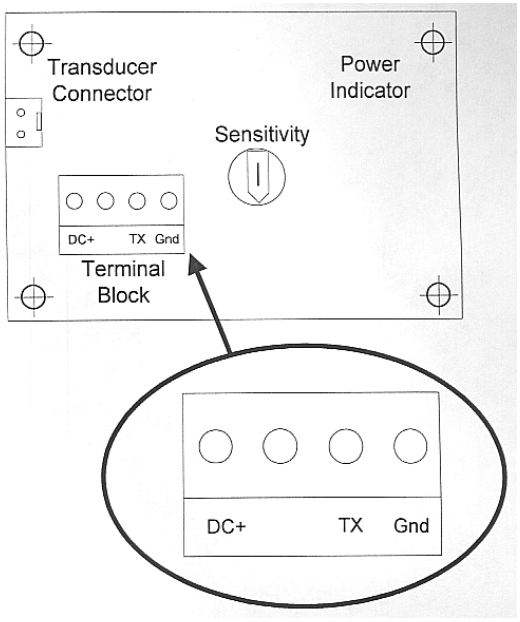
Connections

Ultrasonic transducer

The ultrasonic transducer is provided with a cable attached. Connect the transducer cable (2-pin brown female Molex connector) into the mating *Transducer Connector* on the circuit board.
The two BLADE terminals press onto mating terminals on the transducer. The shield end (ground) should be attached to the terminal of the transducer's outer shell, placing the outer shell at ground potential.

Power Input

Connect a +8 to 24 volts DC power supply via the ***DC*** + and ***GND*** terminals of the *Terminal block* Connecting the power backward will not damage the board. As soon as you apply power, the *Power Indicator* will light and the transducer will begin clicking



repetitively.

RS-232 Data Output

The system provides an RS-232 serial data output on the *TX* terminal of the *terminal block* as shown in the above drawing. There is no serial data input. The output is connected as follows to an RS-232 device input:

Sensor Terminal	Input Device	RS-232 Cable
TX	RS-232 In	RED
Gnd	Ground	GREEN

The RS-232 cable included with the sensor connects the sensor to a standard personal computer serial port (COM1 or COM2). One end of the cable is a 9-pin female (DB9F) connector that mates with a standard PC 9-pin COM port connector. The other cable end has 2 tinned wires that connect to the sensor terminal block listed above in the Sensor Terminal column.

Operation

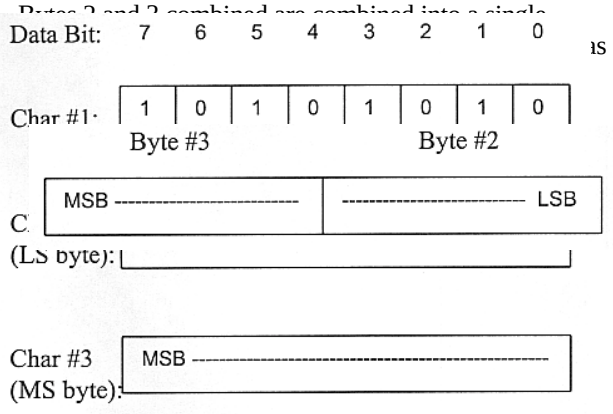
Starting the sensor

Following installation and connection according to the preceding sections, the sensor starts running as soon as the DC power is applied.
When the sensor is running the *Power Indicator* should be ON and a repetitive clicking heard from the transducer.

Distance Calculation

The sensor's measured distance is represented by the data transmitted on the *TX* terminal of the terminal block. The data is contained in 3-characters burst with the following definition:

#1:55H (sync character)
#2:LSByte of count data
#3:MSByte of count data
Bytes 2 and 3 combined are combined into a single



The distance can be calculated from the 16-bit data value as follows:

Inches = Value * 0.013536

The maximum count value is about 8865, representing a distance of 10 feet (120 inches). Targets closer than 6 inches will generally return values down to about 5.2 inches. If the sensor does not detect a target within 10 feet, the sensor transmits a zero value.

Software

A QuickBasic example program is provided on the included floppy disk that will read the sensor data output and display the measured distance on a personal computer screen. The following files are provided on the diskette:

JAMECO1.EXE -- DOS executable program
JAMECO1.BAS -- QuickBasic source code for JAMECO1.EXE showing how the programming and display of sensor data are accomplished.
Run the program as follows:

1. Insert the floppy disk into the computer. The program can be run from floppy, or the 2 files listed above can be copied to a subdirectory on the computer's hard drive and run from there.
2. Connect and power the sensor as described previously in Getting Started.
3. Run the program by typing JAMECO1 at the DOS prompt. This runs the executable file. The program can also be run as a DOS task under Windows 3.1 or Windows 95.
4. The program will first display "Which COM port is the sensor connected to (1/2)?" Type the number 1 or 2 depending upon which port you are using, then press the <Enter> key.
5. The program now displays distance. A zero value is displayed if no target is detected within 10 feet. The data is updated every 50 mSec. To exit the program, hit any key.

Refer to the source code file JAMECO1.BAS to understand how to read sensor data and calculate the distance.

Performance

Update Rate

The sensor measures distance repetitively at an interval of approximately 50 milliseconds. This is the interval between the "clicks" heard from the transducer. After each measurement, the 3 characters of data are transmitted on the RS-232 output.

Target Considerations

The target must reflect the ultrasound energy back to the sensor. Sensor performance will be affected by the strength of the "echo". Flat surfaces are best when perpendicular to the beam direction. Curved surfaces are generally good targets because a portion of the energy is generally reflected directly back to the sensor.
Low-density materials including some foams, cloth and powders may exhibit reduced detection range, or can absorb or be transparent to ultrasound. In many cases these materials are easily detected, so testing a material sample is recommended. Increasing the sensor's gain using the sensitivity adjustment may be required.

Temperature Effects

The most significant factor that affects measurement accuracy is temperature. At room temperature, a change of 10 degrees will result in approximately 1% change in the speed of sound and therefore the same change in the distance output. This model sensor does not compensate for temperature affects.

Precautions

- Keep unintended targets from transducer's field of view. Keep the beam pattern in mind.
- Keep transducer away from ultrasonic noise sources, such as pressurized air nozzles

Adjustments

Sensitivity

This adjusts the electronic sensitivity to the strength of the ultrasonic echo being returned from the target object. Very small or sound absorbing targets may not send a very strong echo and therefore may require increased sensitivity for stable detection. The sensitivity potentiometer is located next to the terminal block on the solder side of the circuit board. The unit is shipped at mid range and in general it does not require adjustment. Sensitivity can be increased by rotating the potentiometer clockwise and decreased by counterclockwise rotation. Full rotation of the pot is 180 degrees.

Ultrasonic Tuning Adjustments

The ultrasonic tuning adjustments consist of a transformer T1 (silver case) and inductor L1. These generally do not require adjustment unless the cable length to the transducer is lengthened.

To adjust these components:

1. Put an oscilloscope probe on test point TP1 and set the scope to trigger on the transmitted pulse. This test point is a hole in the PCB that is labeled on the component side of the board.
2. Using delayed sweep, monitor a target echo signal and adjust T1 for maximum amplitude.
3. Using the same signal as in step 2, adjust L1 for maximum amplitude.

Transducer Cable Length

As the cable length is increased, sensitivity will decrease. A practical cable maximum length is 20 feet, and longer cables should be shielded in electrically noisy areas.

In Case of Difficulty

Basic Checkout

With DC power applied to the sensor the Power Indicator should be ON and a clicking sound should be heard from the ultrasonic transducer.

If the Power Indicator is not ON check the power connections. The board will not be damaged by a reverse polarity connection.

If the Power Indicator is ON but the sensor is not clicking, check the cable connections between the circuit board and ultrasonic transducer. Look for broken or shorted wires or loose connectors.

Common Problems

Output stuck at short distance value

1. An object is near the front of the sensor that is being detected, possibly associated with the mounting arrangement.

2. The sensor is "self-detecting" its own transmit signal. Reduce the sensitivity by turning the Sensitivity adjustment counterclockwise.

3. No target is being detected. Place a target in front of the transducer at a known distance and test for a reasonable voltage value.

Repairs and Returns

If you need to discuss a problem or return a unit please call the following number for technical support:

Jameco Electronics
(415)592-8097 (voice)
(415)592-2503